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## ALFALFA

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This wonderful forage plant was introduced into this state some time between the years 1851 and 1854, and has not only become, in the time that has elapsed since its introduction, the standard forage plant in California, but it has also become known and appreciated far beyond the boundaries of the state. The annual value of the crop in California approximates some thirty-five millions of dollars now, and the acreage devoted to its culture is constantly being increased. In view of these facts, and recognizing the fact that concise information is demanded by both old and new planters, the following summary of practices is presented.

### SOIL REQUIREMENTS

Alfalfa is a deep feeding plant, sending its long tap roots far down into the soil for nutriment. It has been known to penetrate to the depth of twelve feet in a single season, and the roots of exceptionally deep rooted plants have been traced to the depth of sixty-five feet. This deep feeding character of the plant should be noted, and, so far as possible, the fact should be taken into consideration by the intending planter.

The soils in which free water is found close to the surface should be avoided. Under these conditions the deep root is likely to decay, and the plant will suffer, if it does not die. A deep, well-drained, moderately heavy loam soil, free from hard pan, with no standing water closer than fifteen or twenty feet, is to be preferred to all others. Our best alfalfa fields are on such soils as these.

While the alfalfa plant prefers a deep, well drained, moderately heavy soil, it readily adapts itself to a great variety of soils, and some very profitable alfalfa fields are to be found on practically all

types of California soils. However, it will not remain profitable as long upon the shallow soils as it will upon the deeper soils. On soils that are underlaid with hardpan or have a water-table at a depth of about three feet, alfalfa will not remain profitable more than about five years, whereas, if given proper care, it will last from twenty to thirty years upon deep, well-drained soil. In general, it may be said that the deeper the soil, the longer the alfalfa will remain in good condition.

#### CLIMATIC REQUIREMENTS

The first alfalfa seed brought into California came, no doubt, from Chili. Planted in the great inland valleys of the state, its production here was begun under climatic conditions very similar to those of the plant's native habitat. Soon, however, it was found to be adaptable to conditions very different from those found in the great valleys, and it is now a staple crop throughout the entire state. Alfalfa, however, seems to do best away from the immediate influence of coast conditions. For its growth and production, a long, hot growing season is desirable, and the longer this growing season is, if other conditions are favorable, the greater will be the number of crops per year, and the greater will be the yield. This optimum of climatic conditions then should be sought by the intending grower. Entirely satisfactory plantations of certain varieties of alfalfa are to be found, nevertheless, in regions of this state in which the growing season is short. We are therefore justified in saying that the adaptability of the plant allows of its use under a great variety of climatic conditions.

#### WATER REQUIREMENTS

Under California conditions of climate and soil, the intending planter of alfalfa should have irrigation water at his command. In general, this command of water may be considered as an essential for success. It is true that many alfalfa fields are to be found in this state where no facilities for irrigation exist, yet good crops are harvested. Still, the success of these non-irrigated fields is not so great as it would be were water available when needed. Both pocket gophers and squirrels are a pest in alfalfa fields, and the most effective way to destroy them is by drowning. If the general soil conditions do not seem to demand the use of irrigation water for the success of the crop, the possibility of drowning out these pests must be considered.

## PREPARATION OF THE LAND

Most of the land that is being seeded to alfalfa in this state, has been used previously either for pasture or grain growing purposes. In either case, but more especially in the latter, the physical condition of the soil is bad. Almost invariably we find in this land, at a depth of a few inches, what is commonly known as "plow sole" or "cultivation hard pan." This is in no wise to be considered as a true hard pan, but is, more correctly speaking, a compaction of the finer particles from the upper stratum of the soil into a very firm, impervious layer of soil just beneath the cultivated surface.

This subsoil must be broken up before the air, water, and plant roots can penetrate to the deeper portions of the soil. The first move, then, in preparing land for alfalfa, is to plow it deeply, so as to fully break up the subsoil. This deep plowing should be done before the land is leveled, otherwise in the process of leveling, the hard subsoil in the lower places of the field will be covered so deeply that it will be impossible to break it up later. In many cases that we have studied the plowing has been done after leveling, and, as a consequence, the lower places were filled in with earth from the high places, and the subsoil was not broken up. The result has been that in a short time—a year or two—the field presented a spotted appearance and the alfalfa failed to produce in the places where the hard subsoil had not been broken.

The land should be well leveled so that it can be irrigated in the most economical way, and so that the water can be distributed uniformly over the field. To do this the services of a surveyor should be secured to determine the levels. If the square check system of irrigation is to be used, the checks should be of such a size as will permit of the high point being covered with water to a depth of three inches at least, with a levee system of not more than sixteen inches high at its highest point. The levees should be made broad and low, so that the various implements, mowing machines, rakes, wagons, etc., may be used over the field as a whole, without reference to the levees. When the levees are not at right angle or parallel with the lay of the field they are more difficult to mow and rake over, hence contour, irregular levees should be avoided so far as possible. Occasionally the slope of the land may be such that contour lines will have to be used. If this is the case and the land is rather heavy so that it will

not wash readily, the water can be turned directly from one check to the other through the border without constructing lateral ditches. This permits of a very cheap system of leveling and checking. If the soil is sandy it will not stand the washing, and lateral ditches for carrying the water must be constructed as with other systems of checking. In the very heavy soils where the water percolates downward very slowly, the contour system is to be recommended, for with this system it is possible to hold the water within every given check long enough to force deep percolation. It may then be drained into the next lower check before it has stood long enough to kill the alfalfa.

In certain cases it may be desirable to use the strip system of checking. This system can be used to advantage where the soil is moderately heavy and where the slope is not too abrupt. If this system of checking is used on the sandier soils, the slope should be as great as possible and yet not great enough to allow excessive washing. The strips should range from thirty to seventy-five feet in width, and on the heavier soils should range from one-eighth to one-fourth of a mile in length; on the sandier soils the length should range from one-eighth to one-sixteenth of a mile. Regardless of the system of checking, the land should always be plowed and irrigated and then re-leveled with a scraper before seeding. Each particular piece of land presents its own problem regarding the best system of checking and it is well for the inexperienced planter to call upon his farm advisor or upon the agricultural department of the University of California, Berkeley, for detailed advice regarding the system best adapted to his soil and water conditions before spending much money in checking his land.

While deep plowing is essential in the proper preparation of land for alfalfa planting, it should be remembered that the alfalfa seed demands a firm seed bed for its best success. Therefore, after the land has been deeply plowed, leveled and checked and then replowed, it should be gone over carefully with some sort of compacter. An ordinary roller followed by a light harrow may be used. The disk cultivator, heavily weighted, with the bar set straight has been successfully used as a sub-surface packer. Any implement that will compact the subsurface somewhat and still leave the surface fairly loose may be used.



## SEEDING AND VARIETIES

The first question that will probably arise in the mind of the intending planter when it comes to the choice of seed, will be as to the best variety of alfalfa to plant. Studies of this question indicate that for the general conditions found in California, the Chilian alfalfa is the most satisfactory and for ordinary plantings in our "great valleys" throughout the north and south where irrigation is to be practiced, this variety will probably give the best results.

In localities where irrigation is impossible, the Turkestan variety will be the most satisfactory. This is a very hardy variety and will stand cold weather conditions better and also produce a crop on less water than will the Chilian variety. The Turkestan alfalfa stays dormant much later in the spring and also goes dormant earlier in the fall than most other varieties. The hay of the Turkestan alfalfa as produced in California is not as fine and clean as the hay of the Chilian alfalfa and it is not to be recommended for irrigated lands in the large interior valleys.

Another variety of alfalfa known as the Arabian is desirable for certain special purposes. It is a "short life" perennial and is not recommended except in short rotation or for interplantings in orchards where the stand is only desired for two or three years.

Another variety which has met with considerable favor during the past few years is the Peruvian. It is a rather tall, rank growing variety which will, under most conditions, produce a heavier yield than the common Chilian. It has an erect habit of growth and starts growing earlier in the spring and continues later in the fall than most varieties. It has a tendency to become a little coarse and produce an inferior quality of hay, but this can be mostly overcome by planting it rather thickly and exercising care not to allow it to stand too long before cutting.

The Grimm alfalfa is another variety that is grown to advantage in some localities. It has a branching root system which makes it better adapted than other varieties to wet, shallow soils. It is also very hardy and this, together with its branching root system makes it well adapted to some of the mountainous valleys of this state which have a water-table comparatively near the surface.

Many other varieties of alfalfa have been tested in California, but so far the choice seems to be between the above-named varieties.

Good, clean, vigorous seed of any variety is necessary to secure a good stand. The source of this seed, that is, the locality where grown, should be known by the planter so that its desirability may be, in part at least, determined. The intending planter can have his seed tested as to purity and germination, by sending a four-ounce sample to the Experiment Station, Berkeley, California. This service is done gratis and every grower should take advantage of it so that he may be sure of using seed that will grow, and be free from dodder and other noxious weeds. The amount of seed used per acre varies a great deal with different planters, but careful studies of the question indicate that if a clean, vigorous seed is put into a good seed bed, from 12½ to 15 pounds per acre is ample. Using more of such seed under such conditions would mean waste.

This seed should, for best results, be drilled into a well-prepared seed-bed and under most conditions no nurse crop used. Some planters use a nurse crop of some cereal, but usually the crop does more harm to the young alfalfa plants by robbing them of moisture, than it does good in fancied protection. The nurse crop is recommended only when fall seeding is practiced under conditions where weed growth is bad, or where the land is sandy and subject to blowing. In the former case it will help keep down the weeds and in the latter it will help hold the sand.

The time of planting will depend altogether upon the frost conditions in the locality where the planting is to be done. The fact should be noted, that the alfalfa plant, when in the seed leaf stage, is easily killed by frost. After it has passed the seed leaf stage, it is much more resistant to frost. If, then, frosts are likely to occur in the regions where the plantings are being made in the fall, seeding should be postponed until spring, when danger of cold weather is over. In general, the best results will probably be secured by sowing as early as possible in the spring to avoid frosts.

#### INOCULATION

It is a well recognized fact that, for full success in growing alfalfa, the plants must be supplied with nitrogen gathering bacteria. These minute organisms, so essential to the proper growth of this plant, are usually present in our California soils, and as a general thing artificial inoculation is not necessary except where new plantings are at some distance from older fields. Pure cultures of bacteria may be obtained

on the market for the purpose, and under some conditions it may be desirable to use these. Generally, however, a perfect inoculation can be obtained by broadcasting one or two hundred pounds of soil, from some well-growing alfalfa field, over each acre of the new field. This inoculated soil should be well harrowed into the land before seeding. The process is not difficult and requires no technical skill.

Inoculation can also be satisfactorily accomplished by what is known as the "soil suspension" method. A quantity of soil is taken from some field where the alfalfa is growing well, and the soil contains the desired bacteria. This is indicated by the nodules which can be found upon the roots of the growing plant. To a given volume of soil add two or three volumes of water. This is stirred vigorously several times during one day, and then the earth is allowed to settle. The alfalfa seed is then dipped in this water, which now carries the bacteria, after which it is placed in the shade and dried enough so that it separates readily, then planted immediately. This method has the advantage of being cheap, easy and effective. It is the part of wisdom for the planter of alfalfa to insure the presence of the necessary bacteria.

#### IRRIGATION

It has been previously pointed out that no definite rule can be laid down regarding the amount of water to use in growing alfalfa. In general, however, experience indicates that frequent shallow irrigations are to be preferred to occasional heavy floodings. In the writer's experience and observation an irrigation of four or five acre inches, ten days before cutting, brings the best results on most soils. Irrigating at this time has a tendency to overcome leaf shedding, and it should be remembered that 60 per cent of the value of the alfalfa is in the leafage. It will also cause new growth to start up from the crown as soon as the crop is cut, and in this way the new crop will be growing while the previous crop is being harvested. On heavy soils irrigation before cutting will also have a tendency to keep the soil in better physical condition as it prevents the sun from shining directly upon the wet earth, thus reducing the tendency to bake and crack.

It is very much to the growers' advantage to keep his alfalfa growing steadily throughout the growing season, and to do this it may be necessary on some soils to irrigate lightly twice between cuttings.





The commonest failing of an alfalfa grower is to add too much irrigation water and by referring to the table on page 8 he can easily determine in acre-inches the approximate amount of water he is adding.

This table is presented to enable the man who knows the size of the irrigation head, and the time required to irrigate an acre, to readily determine in terms of acre inches, the amount of water he is using upon his land. For example, if the head is ten second feet and the land is irrigated at the rate of one acre per half hour then it can be ascertained easily from the table that about five acre inches of water are being added. Or, if the size of the irrigation head is known and the farmer decides that he wants to add five acre inches of water, then he can readily determine from the table the time required to irrigate an acre. For example, if the irrigation head is five second feet then he can see from the table he will need to irrigate at the rate of one acre per hour to give him five acre inches of water. Or, if the head is twenty second feet, then he will need to irrigate at the rate of one acre per quarter of an hour (fifteen minutes) in order to add five acre inches of water.

A fine, sandy loam soil requires about nine-tenths of an acre inch of water to wet the soil to a depth of one foot. The heavier soils would require a little less than this, while the sandier soils will require a little more. When allowance is made for soaking up lateral ditches, losses by seepage through boxes, etc., the farmer might roughly figure that it requires about one acre inch of water to wet the soil one foot in depth.

#### FERTILIZATION AND RENOVATION

Most of our California soils are well supplied with the mineral plant food necessary for success with alfalfa, but in many of these soils there is a deficiency of humus or decomposing organic matter. In this case the deficiency can be supplied by growing a green manure crop on the land, and plowing it under before seeding to alfalfa. The character of the green manure crop will vary with the local climatic conditions, though for most of the state the best results can probably be secured by the use of rye, seeding it in the fall at the rate of about eighty pounds per acre.

When sufficient quantities of barnyard manure are available it is to be recommended rather than green manure crops. To use barn-

yard manure to the best advantage it should be scattered with a manure spreader at the rate of about ten tons per acre and plowed under. When plowing under either barnyard or green manure, the soil should be thoroughly settled and firmed around the material that is plowed under before seeding, or it might be firmed by using a heavy corrugated roller immediately after seeding.

After the first year good results can usually be secured by using some gypsum (land plaster) or superphosphate (soluble phosphate). This is especially true of the sandier and shallower soils such as characterize a good deal of the east side of the San Joaquin Valley. The most approved method of using either of these materials is to apply them at the rate of from 250 to 300 pounds per acre during the dormant period. The second application of about 200 pounds per acre is sometimes added with good results just after the third cutting. The question often arises as to whether superphosphate or gypsum should be used. Generally speaking, the results obtained from the use of these two materials will probably not differ greatly so far as increased yield is concerned, but excessive use of gypsum is not recommended. Where one or the other of these materials is used once or twice each year superphosphate should be used every second or third year.

Barnyard manure is the best fertilizer for alfalfa and should be carefully preserved and used. It brings good results when plowed under before seeding and also is very valuable to use as a top dressing. When used in this way it should be applied upon the alfalfa with a manure spreader during the dormant period.

Alfalfa should be thoroughly renovated during the dormant season each year. This will loosen the top soil, and afford good aeration which is essential to best results with alfalfa. Renovation will also put the soil in better shape to absorb and hold moisture. The aim to be accomplished when renovating alfalfa is to stir the soil as much as possible and do the least damage to the alfalfa crowns. An ordinary spring-tooth renovator made on the order of a spring-tooth harrow is probably the best tool for most conditions but the cutaway disk harrow or the ordinary spring-tooth harrow can be used.

#### TIME OF CUTTING

Alfalfa should not be allowed to become too mature before cutting as when this occurs there is sure to be considerable leaf dropping and

loss of food value. There are two good rules to follow in determining the time to cut. The first, and a fairly good one, is to cut when the plant is about one-tenth in bloom. The second and perhaps the more reliable, is to cut when new growth begins to appear at the crown of the plant. It should be remembered that the alfalfa plant grows by adding on the tip, and if this growing tip is cut off it sets the plant back, to the extent that it must form a new growing tip, before growth can be continued.

In order to secure good alfalfa hay great care should be exercised in making and curing to prevent the loss of leaves and excessive bleaching and drying by the sun. In the interior valleys alfalfa hay should usually be raked the same day that it is mowed and shocked the following day. During the first and last cuttings it might be necessary to allow it to cure a little longer in the swath, but in all cases it should be placed in the shocks before the leaves have become dry and brittle. The hay should be hauled and stacked just as soon as it has cured enough in the shocks so that it will not heat.

Finally, the alfalfa planter should remember that he is dealing with a plant of high food value, capable of being used as a ration for all farm animals, and a plant that will under the best conditions continue to produce well a generation or longer. He should, therefore, spare no pains in getting the best results. Proper care at all points will accomplish this.

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